APPENDIX I

Memo

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TO: Nolte Associates, Inc.
FROM: Kleinfelder

SUBJECT: Technical Memorandum
Groundwater Treatment and Disposal Options During Construction and Post Construction Moisture Considerations
Reno Rail Corridor Project
Reno, Nevada

This technical memorandum provides a listing and description of options for the treatment and disposal of water that would be encountered during the lowering of the Union Pacific rail tracks through downtown Reno, Nevada. It also includes a discussion of moisture in the finished facility.

The options discussed herein include treatment for reuse or for a non-use discharge. The level of detail is preliminary since the information on water volumes, and average concentration of regulated constituents is preliminary. We have itemized our assumptions in order to provide a comparison of the benefits of each option.

CONSTRUCTION

Assumptions and Project Specifics

Kleinfelder reviewed the plans and profiles prepared for the depressed rail design options, and the information obtained from the soil from the borings and the analytical results. Groundwater samples were collected and analyzed and found to exhibit petroleum and chlorinated hydrocarbons from historic contaminant releases. This groundwater condition indicates that selected options for reuse, treatment and/or disposal will depend on the following conditions:

- Volume of water to be removed;
- The presence and concentration of petroleum and chlorinated hydrocarbons;
- The presence and concentration of inorganic chemical species and parameters such as temperature, nitrogen, phosphorous, total dissolved solids, and
- Conveyance and discharge options available at the time the water is removed.

Table 1 summarizes the concentrations of specific chemicals and discharge parameters with which each reuse and discharge option must comply.

For each discharge option some form of sediment removal must be considered to meet discharge criteria. Free petroleum products could be encountered floating on the groundwater, and will have to be removed through a separate process. It should be noted that free product was not found in the soil borings installed as part of Kleinfelder's subsurface assessment for this project, however free product has locally been found historically under downtown Reno, (SRK 1995).

A summary of the petroleum analytical results of groundwater samples collected from boreholes along the railway alignment is located in Appendix D of this geotechnical report. These analyses were conducted by Alpha Analytical of Sparks, Nevada. For the purposes of estimating the quantities of groundwater to be removed, it was assumed that the trench walls and bottom should be sufficiently sealed to prevent significant infiltration of water into excavated areas. Based on the trench section consisting of a 1% grade from the west and a 1% grade to the east of the apex, the trench change excavation would be about 8 feet below the water table at the lowest point. Using the steeper 1.2% grade would place the trench excavation about 15 feet below the water table at the lowest point. These depths below the water table for construction should be considered approximate since as noted in the geotechnical report, seasonal groundwater elevation variation of 1-1/2 feet to 6 feet exists in the study area.

Given the geometry of the of a 1.2% grade trench section proposed for a depressed trainway, 20%-30% (2.6 million – 3.9 million gallons) of the volume of space below the water table would consist of groundwater and the remaining would be soil. Some of the water would remain with the soil and not drain when excavated.

Since it is anticipated that the groundwater encountered during construction will contain either petroleum or chlorinated hydrocarbons, it will have some impact on construction activities. Sealing the walls and bottom of an area to be excavated prior to such activities would greatly reduce the amount of water to be managed. It is recognized that at the time of excavation there may be some small voids in the bottom seal that would allow for additional water to seep into the excavation. However, these void spaces would be expeditiously sealed to prevent excessive inflow of water to the area excavated.

Given the construction scenario of excavating and temporarily stockpiling saturated soil, there will be water at more than one location that will need to be managed. These locations would be in the trench itself and within a lined soil stockpile area with an associated water collection sump.

For the purposes of estimating the concentrations of regulated organic compounds in the groundwater to be reduced and/or removed, we made the following assumptions based on existing data:

- TPH as oil and/or diesel of up to 8.4 mg/l;
- Tetrachloroethene (PCE) of up to 0.0083 mg/l;
- Chloroform of up to 0.014 mg/l;
- Bromoform of up to 0.0019 mg/l;
- Bromodichloromethane of up to 0.001 mg/l; and
- Floating product could be encountered.

The inorganic chemistry and other man-made chemicals of concern in the groundwater, within the study area has not been systematically evaluated. This data will be necessary to better assess the treatment/reuse/disposal options.

We used the foregoing assumptions in selecting and evaluating the water treatment options (see attachment). The accuracy of these assumptions vary. Some cannot yet be independently verified, and some may substantially vary based on decisions made during and after the EIS process. These assumptions and values are intended only to be general in nature, to serve the purpose of evaluating the various options, and to enable a shorter list of viable options to be selected and subsequently reviewed in greater and more accurate detail.

Preferred Options

Given the discussion of the various water treatment and disposal options presented in the attachment it is our opinion that the best options presented include:

1) Treatment of the water using a two trailer system. The first trailer will consist of a large sediment settling tank followed by a separate tank that contains a secondary sediment filter and granulated activated carbon system. This type of system is transportable and can treat a wide range of constituents to include sediment, free floating fuel, and a variety of man-made organic chemicals.

2) Disposal of the water through the sanitary sewer. This option is easiest to permit, has readily obtainable discharge standards and multiple discharge locations are available throughout the project area. Monitoring of the discharge will be required for both flow and quality, however, monitoring requirements on previous projects have been reasonable with respect to the magnitude of the task at hand.

We believe the foregoing provides a useful review of options for the reuse, treatment and disposal of groundwater to be generated by the lowering of the railroad through downtown Reno.

POST CONSTRUCTION/OPERATIONS

Water seepage into the trench section once it is completed will be primarily dependent on the permeability of the walls and floor of the trench section below the water table. Typical grouts using for this type of application have a permeability of 1×10^{-6} to 1×10^{-10}. Using these values and known site conditions reasonable comparison may be drawn between this proposed project and the Alameda Corridor project in southern California. The Alameda Corridor rail project involves installing tracks in a trench that is also partially below the water table; where the maximum depth below it is about 15 feet (similar to Reno). Specifications for the Alameda project call for a maximum allowable moisture volume of 5,000 gallons/mile/day.

The specifications for that project are similar in that the trench bottom will be at a similar depth with respect to groundwater as in Reno. However, part of the proposed grouting process at Alameda will include soil/grout mixing. This method results in higher permeabilities than may be anticipated by the fabrication of a solid concrete or grout wall and floor structure. Therefore, the anticipated seepage of 5,000 gallons per day per mile of trench below the water table specified for the Alameda project may be considered conservative for this project. An examination of that volume of pore water as it may relate to this project follows.

- Pore water volume: 5,000 gallons/ day/mile, approximately 245,000 cubic feet of water per year;
- Length of submerged system: Approximately one mile using the 1.2% grade scenario;
- Total submerged surface area: Approximately 350,000 square feet;
- Average annual pan evaporation rate: 4.5 feet; (Washoe County Department of Water Resources, Personal communication)
- Annual Evaporation Potential: 1,575,000 cubic feet; and
- Daily evaporation rate: 32,000 gallons/day /mile or
- The moisture will, on average, evaporate at a rate that is six times faster than it enters the facility

The above figures suggest that the seepage water will be evaporated prior to being evident in the trench. Given this operational scenario it is unlikely that this moisture will need to be managed within the facility once constructed, even using the 1.2% grade option. At lesser grades, (1.0%), the moisture issue would be considerably lessened, due to the decreased length and volume of the trench below groundwater.

During the winter months, ice could form the walls and floor of that portion of the trench below the water table. Ice formation would be as a result of the freezing of water vapor moving through the concrete. Assuming a concrete permeability of as much as 1×10^{-6}, there would be in excess of a quarter inch of ice on these surfaces following a subfreezing event of 10 days.

TABLE 1

Influent Standards						
Discharge Option	TPH	Tetrachloroethene	Halogenated Hydrocarbons	TDS	Nitrogen	Total Phosphate
Sanitary Sewer	100[2]	0.005	0.100	500	10	N/A
Truckee River/ Storm Drain	N/A[1]	0.005	<0.100	90[3]	<0.3[3]	<0.1[3]
Public Supply System	None Detected	0.005	0.100	500	10	N/A
Reinjection	N/A	0.005	0.100	500	10	N/A
Infiltration	N/A	0.005	0.100	500	10	N/A

1. N/A-No standard available
2. All concentrations in mg/l
3. There is also a total maximum daily load standard for these constituents on the Truckee River

ATTACHMENT

Discussion of Treatment and Disposal Options

The options listed below reflect methods may be practical for the treatment and disposal of water expected to be generated during construction of the lowered section of the rail tracks. More than one option of treatment and disposal may be selected, based on the volume of water, the presence and concentration of petroleum, chlorinated hydrocarbons and other constituents, the type of potential local uses/treatment available at the time the water is generated, and the economics of each option.

The options Kleinfelder researched include:

I. <u>Water Treatment Options</u>

A. Sediment Removal
- Baker type settling tanks
- Fluctuation tanks
- Filtration units

B. Volatile Organics
- Air/Ozone sparging
- Air stripping
- Carbon adsorption

C. Heavy Petroleum Hydrocarbons
- Carbon adsorption
- Ozonation and Peroxidation

D. Free Floating Fuel
- Separator Tanks

II. <u>Disposal Options</u>

A. Reuse
- Treat for reuse as potable water by the Sierra Pacific Power Company

III. <u>Non-use Discharge Options</u>

A. Treat and discharge to the Truckee River
B. Treat and discharge to the Truckee Meadows Wastewater Reclamation Facility
C. Treat and discharge to the subsurface via re-injection wells
D. Treat and discharge to the subsurface via infiltration ponds

A description of these options along with their applicable benefits and disadvantages are also included for each option.

Discussion of Options

The following treatment and disposal options address the groundwater generated during this project as defined. During typical construction activities ground water usually becomes turbid. In addition, the proposed construction site contains numerous chemicals that will need to be addressed. Each of these having individual characteristics that lend themselves to be removed most cost effectively by a given process.

Given the varied characteristics of the groundwater to be encountered through the project length and its susceptibility to change from the time this study was performed it is anticipated that overall treatment will require a several step process that will be modified with time from that discussed herein. The treatment options discussed below are grouped by parameter/chemical to be removed or modified.

I. Water Treatment Options

A. Sediment Removal

Baker Type Settling Tanks
These tanks are typically large capacity (20,000 gallon) tanks that are basically baffled tractor-trailer style tanks. The tanks are typically used to settle out silt and sand from a discharge stream. Separation of free-floating fuel from a discharge stream may also be accomplished. The advantages of these tanks for the proposed project are:

- Portable using a standard, over-the-road, tractor;
- Used to remove both coarse grained material and free fuel from a discharge stream;
- Set up and operational costs are relatively low due to the simplicity of operation; and
- They can typically handle a discharge stream of up to 150 gallons per minute per tank.

Disadvantages of using these tanks include:

- The large size precludes their use in tight working areas;
- They can only handle about 150 gallon per minute each; and
- Sediment removal may not be sufficient enough to meet many discharge requirements.

Flocculation Tanks
Flocculation tanks are typically used in the waste water industry to settle out sediment and other solids from a waste water stream. These tanks come in various sizes. However they are

typically large and use mechanical components to allow for the mixture of the flocculent and water. Issues to consider with this type of technology include:

Advantages:

- High efficiency rate for the removal of sediment;
- May be readily available; and
- Proven technology.

Disadvantage:

- Typically need large tank to allow for the mixing and settling of sediment; and
- Mechanical in nature and require an experienced operator.

Filtration Units
There are a number of filtration units on the commercial market that are used to remove fine sediment down to the low micron size range. Capacities of these units range up to 1,000 gallons per minute. Operational costs are typically dependant on flow rate and sediment concentration. Advantages and disadvantages of using these types of sediment removal systems are as follows:

Advantages:

- High efficiency sediment removal allows for a multitude of discharge applications;
- Self contained;
- Readily available and easy to set up; and
- May either be rented, leased or purchased for a project .

Disadvantages:

- Filters will rapidly become clogged when used to treat water with a high sediment content as to be expected during construction. Thus they must be managed and filter costs may be significant; and
- High efficiency filters typically require booster pumps to force water through them and maintain needed operational pressure head.

B. Volatile Organics

Air/Ozone Sparging
This option involves the containment of the water in batches, and the forced, vigorous application of air and ozone in a micro-bubble form through the water. This process physically removes ("strips") the contaminants from the liquid phase (water) to the vapor phase (air) and chemically destroys (oxidizes) the remaining organic materials. Air sparging by itself works best

with compounds with a high Henrys' Constant, which includes all of the known chlorinated hydrocarbons and the light petroleum distillates. However, with an ozonator it will also be effective for the removal of dissolved petroleum in the range of diesel or heavier. This process does not address the inorganic compounds in a predictable and comprehensive manner. Several advantages and disadvantages to using this process include the following:

Advantages:

- May have application on a wide range of organic chemical types to be removed from the water;
- Low maintenance; and
- Not space intensive.

Disadvantages:

- A significant amount of contact time is needed between the air/ozone and the water for efficient removal of the target chemicals. Therefore, high throughput is not anticipated;
- Electrical power is needed for the ozone generator;
- Ozone generators and associated equipment may have a high initial capital cost; and
- Ozone may mobilize heavy metals into the water if they are present in sediment.

Air Stripping
Air stripping involves the forcing air past a film of moving water. As this air passes over the water volatile organic hydrocarbons transfer from the soluble state to a gas and are carried off. There are many trailer mounted commercially available air strippers on the market today. This technology can be used over a wide range of flow rates and chemical concentrations. However it is limited in application to chemicals that are volatile in nature. Since the groundwater within the study area has both volatile organics as well as "heavier end" petroleum products this technology may have limited application during construction.

Carbon Adsorption
This option involves the use of activated carbon in large treatment vessels through which the water is pumped. The carbon removes organic compounds from the water stream by the physical process of adsorption. The carbon gradually adsorbs hydrocarbons until saturation, upon which the carbon must be replaced or regenerated. The canisters can be sized for different flow through rates. Typically, two or more canisters are used in series. This process does not address the inorganic compounds. Advantages and disadvantages of using this type of system include:

Advantages:

- No mechanical parts or systems to maintain;
- Readily available through local sources;
- Efficient at removing a wide range of organic chemicals and some inorganic chemicals from the discharge; and
- Relatively low cost per unit volume for treatment.

Disadvantages:

- Carbon filters are easily rendered inoperable with the introduction of sediment or free petroleum;
- Discharge stream needs close monitoring to assess for chemical breakthrough; and
- Permitting needed for carbon disposal is both costly and lengthy in time.

C. Heavy Petroleum Hydrocarbons

Carbon Absorption
The use of activated carbon to treat the groundwater was presented above. This type of treatment is effective on removing heavy petroleum products from the groundwater, such as diesel, heating and motor oil, greases and other organic lubricants as well as the volatile chemicals as stated above. For this application the advantages and disadvantages of employing this method have been previously discussed.

Ozonation and Peroxidation
Ozonation and peroxidation are two similar water treatment technologies that have been used to remove heavy petroleum products from wastewater. The function of both processes is to physically breakdown the various chemicals through oxidation. Factors considered with these technologies include:

Advantages

- Physical breakdown of the chemicals of concern occur;
- May be used over a wide range of petroleum and of other related chemicals; and
- Equipment may be sized for the specific project.

Disadvantages

- The equipment required is not as readily available as other technologies;

- Use of this equipment poses its own set of health and safety risks. Therefore, skilled operators are desired;
- Although applicable on a wide range of compounds the system may require frequent operations modifications if used along the project site in order to manage the range of expected influent chemistry; and
- Equipment is not as readily available as activated carbon systems.

D. Free Floating Fuel

Separator Tanks
Free floating fuel was not observed in borings or monitoring wells installed as of this project. However, the potential exists for fuel product to be present in limited locations. If fuel is present in the excavation, it will be pumped with the groundwater to a separator tank. The floating fuel product can then be vacuumed off and removed off-site for incineration or other treatment method. There are several local waste management firms that offer this type of service locally. In the event that there is a high quantity of fuel a "skimmer" type pump may be used to transfer it to a temporary holding tank.

II. Water Disposal

Once the groundwater has been treated there are several options for its disposal. Some of the more apparent options are presented discussed herein.

A. Reuse

The water can be treated to Nevada drinking water standards and blended with SPPCo distribution pipelines. SPPCo has indicated their willingness to conditionally receive the water. Advantages and disadvantages to using this option include:

Advantages:

- The water is put to a beneficial use;
- There are water lines in close proximity to the project site; and
- The drinking water standards are less stringent than discharge standards for the Truckee River.

Disadvantages:

- Public perception of drinking/using formerly contaminated water;

- Cost of permitting and physical tie-ins to the water system may be inherently high; and
- Given other disposal method options, this option may not be cost effective given the low anticipated volume.

III. Non-Use Discharge Options

A. Discharge to the Truckee River

The treated water can be discharged to the storm drain or directly to the Truckee River if it meets the standards established by the Nevada Department of Environmental Protection (NDEP) and as specified in the Truckee River Operating Agreement. The attached table shows the discharge standards for total dissolved solids, total nitrogen and total phosphorous. Note that there are maximum discharge concentrations and a total maximum daily load (TMDL) standard to the river. In addition to these standards there are strict discharge standards with regards to the discharge of petroleum and chlorinated solvents to the river.

Technical issues to consider with this disposal option are:

- The portion of the total maximum daily load for target chemicals that would be allocated to this project is unknown since assessment of these figures is currently under examination by others. In addition the Truckee Meadows Wastewater Reclamation Facility currently has intermittent issues with meeting all the discharge goals for the river;
- The maximum discharge concentrations cannot be finalized until an allocation of daily load has been established by permit; and
- Obtaining a discharge permit from NDEP is very difficult and the permit conditions may require very costly and extensive monitoring of the discharge.

Based on these issues we do not anticipate that the direct discharge of water to the Truckee River on a short or long term basis as being a viable option.

B. Discharge to the Truckee Meadows Wastewater Reclamation Facility

The treated water can be discharged to the Truckee Meadows Wastewater Reclamation Facility (TMWRF) if it meets the discharge requirements enforced by the City of Reno Environmental Control Section. Table 1 shows the standards required for the discharge of water to the sanitary sewer from our pumping test performed in 1999. It is anticipated that at a minimum the water would need to be treated for the following prior to discharge:

- Bulk Sediment;
- Free floating fuel; and

- Chlorinated solvents to drinking water standards.

At the present time the cost to discharge to the sewer is about $2.40 per thousand gallons. This cost would be on top of the expense to initially treat the water. Other factors to consider with utilizing this option for the disposal of construction seepage water are:

Advantages:

- There are numerous disposal locations (drop inlets) located along the present rail line that may be used on a temporary basis;
- The water quality standards are not as stringent as those for the Truckee River or potable supply; and
- The primary permitting agency for this discharge is the City of Reno.

Disadvantages:

- Discharge water will need some primary treatment and monitoring prior to discharge. Thus there will be costs associated with treating the water essentially twice; and
- Some drop inlet locations are on lines that run close to present capacity, therefore the closest inlet to a given work area may be of limited use and long discharge lines may result.

C. Treat and Discharge to the Subsurface Via re-Injection Wells

The water can be discharged back into groundwater once the organic contaminants and inorganic constituents have been treated to drinking water standards. Table 1 shows the standards. During construction this option may be limited due to the number of wells and or discharge piping needed to logistically manage the water. Due to potential chemical precipitation and ultimate clogging of well screen and aquifer pores, the chemical and physical dynamics require that the concentrations of some of the inorganic chemicals and other parameters may be lower than the regulated discharge standards. Other considerations include the design of the wells, the aquifer characteristics, and the volume of water to be discharged.

This type of water disposal would need to be permitted through the NDEP under the under ground injection control program. Monitoring of the effluent would be required under this permit.

D. Discharge to the Subsurface Via Infiltration Ponds

The water can be discharged via infiltration basins once the organic contaminants and inorganic constituents have been treated to drinking water standards. Table 1 shows the standards. Considerations include the needed size of the basins. Basin size will be predicated on soil permeability and discharge flow rate. The removal of fine-grained sediment will be crucial to the successful implementation of this option to minimize the plugging of the receiving formation. Due to the narrow width of the construction zone it is unlikely that a reasonable location for these basins may be obtained.